

REMARKS

Claims 1-2, 4, 6, 8, 10-12, 14 and 16-18 are pending in this application, of which claim 1 has been amended and claims 17-18 are newly-added. Claims 3, 5, 7, 9, 13 and 15 have been cancelled.

The Examiner has rejected the claims as follows:

1. Claims 1, 3, 5, 13 and 15 under 35 USC §103(a) as unpatentable over U.S. Patent 6,124,971 to Onderkirk et al. (hereinafter "Onderkirk et al.") in view of U.S. Patent 5,867,240 to Crawford et al. (hereinafter "Crawford et al.");
2. Claims 2, 4, 6, 14 and 16 under 35 USC §103(a) as unpatentable over Onderkirk et al. in view of Crawford et al. and further in view of U.S. Patent 5,576,077 to Bosma et al. (hereinafter "Bosma et al.");
3. Claim 7 under 35 USC §103(a) as unpatentable over Onderkirk et al. in view of Crawford et al. and further in view of U.S. Patent 4,697,885 to Minowa et al. (hereinafter "Minowa et al.");
4. Claim 9 under 35 USC §103(a) as unpatentable over Onderkirk et al. in view of Crawford et al. and further in view of U.S. Patent 5,847,798 to Yang et al. (hereinafter "Yang et al.");
5. Claim 8 under 35 USC §103(a) as unpatentable over Onderkirk et al. in view of Crawford et al. and Bosma et al., and further in view of Minowa et al.;
6. Claim 10 under 35 USC §103(a) as unpatentable over Onderkirk et al. in view of Crawford et al. and Yang et al.;

7. Claim 11 under 35 USC §103(a) as unpatentable over Onderkirk et al. in view of Crawford et al. and further in view of U.S. Patent 5,990,995 to Ebihara et al. (hereinafter "Ebihara et al."); and
8. Claim 12 under 35 USC §103(a) as unpatentable over Onderkirk et al. in view of Crawford et al. and Bosma et al. and further in view of Ebihara et al.

Applicants respectfully traverse these rejections.

Onderkirk et al. discloses a transreflector which increases efficiency and brightness under both ambient and supplemental lighting conditions in visual display applications. In one embodiment, the transreflector includes a reflective polarizing element that reflects one polarization of light and transmits the other. In an alternate embodiment, the transreflector includes a reflective polarizing element and a diffusing element such that the transreflector diffusely reflects light of one polarization and transmits the other. The transreflector is useful for both reflective and transflective liquid crystal displays.

Crawford et al. discloses a transmissive, backlit color twisted-nematic or super-twisted-nematic liquid crystal display employing a front fiber-optic faceplate or optical equivalent as a front retaining element of a liquid crystal cell that increases viewing angle between the display and a viewer while minimizing or eliminating undesirable variations in luminance, contrast ratio and chromaticity is described. The fiber-optic faceplate or optical equivalent includes cylindrical optical features and interstitial cladding material of greater optical index than the cylindrical optical features. The interstitial cladding material may include an opaque mask blocking layer to prevent the

interstitial apertures from diffracting off-axis light into an observers's viewing cone. In particular, the liquid crystal display includes dual negative retarders, and a light shaping element such as a brightness enhancing film on the illumination source that increase the effective viewing angle between the display and viewer while minimizing undesirable variations in display chromaticity, luminance, and contrast ratio. The front fiber-optic faceplate or optical equivalent works in conjunction with the dual negative retarders and the light shaping element to provide an improved contrast ratio with a perfectly symmetric viewing angle and to eliminate grey scale inversions.

Bosma et al. discloses retardation layers based on a super-twisted nematic (STN) liquid crystalline layer. In the retardation layers, the liquid crystalline polymer is placed between glass substrates in which at least one substrate has a thickness of 20-500 micrometers. The use of such thin glass substrates reduces the weight and thickness of the retardation layer.

Minowa et al. discloses a display device and decal for forming a display panel terminal. A thick film conductor is bonded onto the terminal portion of a transparent electrode of the display panel by a dry or wet transfer mounting method and a flexible printed circuit board for a driver is soldered on the thick film conductor.

Yang et al. discloses a liquid crystalline light modulating cell and material having liquid crystalline light modulating material of liquid crystal and polymer, the liquid crystal being a chiral nematic liquid crystal having positive dielectric anisotropy and including chiral material in an amount effective to form focal conic and twisted planar textures, the polymer being distributed in phase separated domains in the liquid crystal cell in an amount that stabilizes the focal conic and twisted planar textures in the absence of a field and permits the liquid crystal to change textures upon

the application of a field.

Ebihara et al. discloses a reflection type liquid crystal display device including a pair of substrates having electrodes, a light scattering type liquid crystal layer interposed between the substrates, a reflection layer liquid crystal layer, and a light absorbing layer disposed over a rear surface of the reflection layer for absorbing a light passed through the reflection layer. The light scattering type liquid crystal layer changes into a scattering state or a transparent state in accordance with a change in a voltage level between the electrodes, and transmits 60% or more of incident light irrespective of the change in the voltage level between the electrodes. The reflection layer has a reflectivity within a range of 10 to 50% for reflecting a forward scattered light passed through the light scattering type liquid crystal layer.

The Examiner has admitted that Onderkirk et al. fails to disclose the use of a super twisted nematic liquid crystal or a retardation film having the relation $n_x > n_z > n_y$, but has cited claim 4 of Crawford et al. for teaching such a relation.

Applicants respectfully disagree. Claim 1 of Crawford et al., from which claim 4 depends, discloses a first negative retardation film interposed between the liquid crystal layer and the front polarizer (which film corresponds to the retardation film recited in claim 1 of the instant application) which has indices of refraction described by the equation $n_{z1} < n_{x1} = n_{y1}$, which does not meet the relation of $n_x > n_z > n_y$, where n_x is the refractive index in the direction of the phase delay axis, n_y is the refractive index in the Y-axis direction, and n_z is the refractive index in the thickness direction.

Yang et al. has been cited for teaching a color absorption layer 52 but, like the references

discussed above, fails to disclose the relation $nx > nz > ny$.

Ebihara et al. has been cited for teaching the use of a solar cell 15 but, like the other cited references, fails to disclose the relation $nx > nz > ny$.

In the present invention, as disclosed in page 7, line 24 to page 8, line 11 of the specification, a retardation film having the relation $nx > ny > nz$ is used. Thus, the film serves as a birefringence layer, the viewing angle characteristic is improved, and the reflection-type liquid crystal display device becomes brighter.

Claim 2 of the instant application recites a "twisted retardation film". By providing the twisted retardation film into a liquid crystal display device wherein an STN liquid crystal cell and a reflection type polarizing film are combined, specific effects can be realized. The effects are described from page 20, line 14 to page 21, line 20 of the specification.

If the twisted retardation film 14 is not provided, there occurs a problem that the light linearly polarized in the direction parallel to the transmission axis 8a which is incident from the absorption-type polarizing film 8 assumes an elliptically polarized state after passing through the STN liquid crystal cell 17. It is therefore unnecessarily colored by the reflection-type polarizing film 10 or cannot pass through as a completely linearly polarized light.

However, by disposing a twisted retardation film in front of the STN liquid crystal cell, the incident linearly polarized light assumes an elliptically polarized state, and returns to "a substantially completely linearly polarized light" when passing through the STN liquid crystal cell. When the substantially completely linearly polarized light falls on the reflection-type polarizing film, "the whole incident light is reflected by the reflection-type polarizing film 10, which appears as a metallic

silver background".

That is, the twisted retardation film compensates a polarization state of the incident light to render the incident light to fall on the reflection-type polarizing film not in a state elliptically polarized but in a state substantially completely linearly polarized, thereby realizing a favorable reflection state.

As described above, the present invention solves problems which arise when an STN liquid crystal cell and a reflection-type polarizing film are combined, by providing a retardation film having relations $n_x > n_y > n_z$ or a twisted retardation film at an appropriate position, and thereby a favorable reflection display can be realized.

These functions and effects are not obvious from the combination of Crawford et al., which discloses an STN liquid crystal cell and a retardation plate, Bosma et al., which discloses twisted retardation film; or Onderkirk et al., which discloses a reflective polarizer.

To better distinguish the present invention from the cited references, claim 1 has been amended to recite a light diffusion layer provided on the outside surface of the absorption-type polarizing film.

In view of the aforementioned amendments and accompanying remarks, claims 1-2, 4, 6-8, 10-12, 14 and 16-18, as amended, are in condition for allowance, which action, at an early date, is requested.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE".

U.S. Patent Application Serial No. 09/269,503

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

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Enclosures: Version With Markings To Show Changes Made

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Claims 3, 5, 7, 9, 13 and 15 have been canceled.

Claim 1 has been amended as follows:

1. (Amended) A liquid crystal display device, comprising:

a super twisted nematic liquid crystal cell in which nematic liquid crystal having a twist angle in the range from 180° to 270° is filled and sandwiched between a transparent first substrate having a first electrode and a transparent second substrate having a second electrode;

a retardation film provided outside said second substrate;

an absorption-type polarizing film provided outside the retardation film for absorbing light linearly polarized in the direction orthogonal to the transmission axis;

a reflection-type polarizing film provided outside said first substrate for reflecting light linearly polarized in the direction orthogonal to the transmission axis; [and]

a light absorbing member provided outside the reflection-type polarizing film; and

a light diffusion layer provided on the outside surface of said absorption-type polarizing film,

wherein said retardation film has relations of $n_x > n_z > n_y$, where n_x is the refractive index in the direction of the phase delay axis, n_y is the refractive index in the Y-axis direction, and n_z is the refractive index in the thickness direction.